

"Should a member make a more favourable position, a greater advantage still would be gained. As the above statement may be regarded as theoretical, and look, *prima facie* too profitable and advantageous to be carried out to the full extent stated, I feel that it is necessary to corroborate the theory by what has actually occurred in practice, and to show the profitable working of such societies. I subjoin an extract from the Fifth Report of the Liverpool Borough Savings' Fund Building Society from 1837 to 1842.

Subscriptions received on 1841 shares ..	£17,404 10 0	
Ditto in arrears ..	40 10 0	17,445 0 0
Extraneous from ..	116 15 0	
Fines ..	139 8 5	
Ditto in arrears ..	1 18 6	
Transfer fees ..	189 5 2	
Interest ..	5 18 10	
Bonus ..	31 13 10	
Forfeitures ..	46 5 6	
Deductions on profit on 1364 shares advanced on mortgages ..	21,659 3 8	22,190 8 9
		36,635 5 9
Amount of profit brought down ..	22,190 8 9	
Deduct expenses ..	252 5 11	
Total profit divided amongst 1841 shares ..	£21,937 10 10	
The net profit on each share ..	37 14 6½	
Amount of subscription paid on each share ..	30 0 0	
Value of each share at end of 6th year ..	87 14 6½	

"The advantages to those members who do not anticipate their shares will be, that they will be entitled, on the termination of the society, to share in the profits realized by its operations, which will not only be in the nature of compound interest on the money advanced, but will also be increased by the bonus, fines, &c.

"To mortgagees an association founded on these principles is of the greatest advantage. In the event of the mortgagee requiring the money lent, the same may be paid by a loan from the society; and so long as a member continues to pay his monthly subscriptions, he cannot be again called upon to pay off his mortgage. By this means a great saving of expense is effected, and the inconvenience of being required to pay off their mortgages suddenly, in one payment, avoided, as well as the risk of loss which might arise from a forced sale of their property or a foreclosure of their mortgages.

"The Act of Parliament under which Building Societies are established limits the amount of each share to £500, and the monthly payments to 11. per share (a member may subscribe for any number of shares), and so soon as the shares are realised, the act also provides that the society shall be dissolved, and the members are required to release each other.

"From what has been already stated, it will appear that the objects of Building Societies are laudable and advantageous, and that such societies are free from the usual objections of joint stock undertakings. As regards the settlements in New Zealand, they may be adopted with safety and benefit; and when the principles upon which they are founded are fully, clearly, and thoroughly understood by the colonists, they must become general.

"I remain, Sir, yours obediently,

"ANTHONY T. HOLBROD.

"London, 15th February, 1843."

INSTITUTION OF CIVIL ENGINEERS.

A VERY interesting discussion took place at the meeting on Tuesday evening last night from the reading of a paper by Mr. J. O. Yorke, on the comparative strength of hollow and solid axles for railways and other carriages. The paper detailed a series of experiments that had been made, in the presence of engineers and other scientific gentlemen, for the purpose of ascertaining which description would best withstand the wear and tear, which it was shown arose chiefly from concussion and vibration, to which these axles were subjected. The first experiments were made to ascertain the amount of dead weight the axles would sustain in the centre. A hollow axle of four inches diameter, with a weight of 7 tons 14 cwt. was deflected 1.16th of an inch; with a weight of 9 tons 2 cwt. was deflected 3.16ths of an inch, without any permanent set; and a weight of 9 tons 16 cwt. gave the axle a permanent set of 1.8th of an inch. With a solid axle, the deflection caused by a weight of 7 tons

14 cwt. was 5.16ths of an inch, with a permanent set of 1.16th of an inch; with a weight of 8 tons 1 cwt., the deflection was 3.8ths of an inch, with a permanent set of 3.32nds of an inch. In experiment No. 2, which Mr. Dockrill, of the London and Birmingham Railway, took notice of, the axles were supported on blocks placed under the bearings. A weight of 5 cwt. was raised sixteen feet high, and fell upon the axle. Upon a hollow axle of four inches diameter, the first blow caused a deflection of 1.1th of an inch; the second blow, 3.1th inches; the third blow, 5 inches; and the fourth blow, 6.1th inches. The axle was then reversed, and the fifth blow broke the axle. The experiment was then repeated with a solid axle 3 and 3.6ths inches diameter. The first blow caused a deflection of 4.1 inches; the second, of 9.1th inches; and the third, of 13 inches. The axle was then reversed, and returned to its original form, about five inches. In the next experiment, with a hollow axle of 2 cwt. and 16ths, weight, and 3.1th inches diameter, the first blow caused a deflection of 2 inches; the second, of 4 inches; the third, of 6.1 inches; the fourth, of 8 inches; a groove was then cut round the axle with a sharp tool, and the sixth blow broke it. With a solid axle of 3.1 inches diameter, the first blow broke it short off at the journal. In the fifth experiment upon journals of a hollow axle, the first blow after nineteen blows; the second broke after thirty-six blows. The remaining journal of the solid axle was then tried, and broke with two blows. The hammer was 38 lbs. weight. The next experiment took place before General Pasley and about forty engineers. It was to knock off the journals of hollow axles. The first was broken by 44 blows; the second, by 58; with solid axle, the first was broken by 33, and 9 reverse blows; the second, by 14 blows. The next experiment was the lifting of a weight upon the axles, when keyed to the wheels, from a height of 14 feet. The first blow upon a hollow axle caused a deflection of 1.1th of an inch, and on a solid axle, 1.1 inch. The second blow caused a deflection of 2.1 inches, and on a solid axle of 3.1 inches. The third caused a deflection of 3.1 inches on the hollow axle, and 4.1 inches on the solid axle, but it did not appear to have the slightest effect upon either of the axles. Other experiments with the journals of solid and hollow axles were then detailed, showing that in almost all cases the journals of the solid broke more readily than those of the hollow axles.

A gentleman connected with the Patent Shaft and Axle-tree Company begged to be allowed to say a few words with regard to the experiments made by Mr. Yorke, particularly as some of the solid axles experimented upon and described as being easily broken were made by that company. It was not his desire to speak as to the relative strength of hollow and solid axles, but merely to state that out of 25,000 axles manufactured by that company, not one had been reported as having failed in use. The company were in the habit of constantly testing their axles, and they had met with no such results as stated by Mr. Yorke, whilst, since the experiments at Camden Town (alluded to by Mr. Yorke) were made, they have broken twenty-five axles at the journals, after being keyed into the wheels; and (with the exception of one axle made of a peculiar iron by way of experiment, which was readily broken) the least number of blows of a 38 lb. hammer required to break one was 138. He called attention to the axle on the table, on one journal of which had been expended 225 blows of a 42 lb. hammer, and 171 blows of a 36 lb. hammer, and on the other 168 blows of a 42 lb. hammer, and 83 blows of a 36 lb. hammer, without either journal being broken (although bent in opposite directions), or put much out of its position. The axle was then bent up by an hydraulic press till the two ends met, but again rebounding to about nine inches from each other on the pressure being removed. He also exhibited the end of the journal of an axle which had been sold to a customer of the company, and taken back for the purpose of experiment, when it required 846 blows of a 38 lb. hammer to break off the part of the journal protruding. Three other journals were likewise exhibited by him, showing in each case extraordinary tenacity to resist fracture. The Patent Shaft and Axle-tree Company were very anxious that the comparative merits of both should be fairly tried, and for that purpose he proposed that they should send ten solid axles to the Wolverton establishment of the London and Birmingham Railway, and the Patent Shaft and Axle-tree Company would be willing to purchase ten of Mr. Yorke's hollow axles for the same purpose, and then let the experiments be tried by disinterested and competent judges, and let them be guided by the result. If the hollow axles were found to be practically the best, the Patent Shaft and Axle-tree Company would be glad to meet the demand for them, for their patent included hollow as well as solid axles.

Mr. Yorke said the solid axles he had experimented upon had been purchased from the best manufacturers. It was evident from the statements

relative to the patent axles that there must be great uncertainty in the making of solid axles. He attributed the breaking of the axles to the crystallization of the iron in the process of making. The longer an axle remained upon the anvil the more likely it was to become crystallized. In the making of the hollow axles there was less vibration, and therefore less probability of its becoming crystallized. Mr. Yorke then detailed the manner in which the hollow axles were made, and observed that in axles of the same diameter with the solid the quantity of metal was one-fourth less. He had no objection to the proposal made by the Patent Shaft and Axle-tree Company, and if they allowed it he would order the iron for making his ten hollow axles from the Patent Shaft and Axle-tree Company, as there could not be better specimens of iron than those produced by them.

General Pasley believed that the statements of Mr. Yorke, so far as he had witnessed the experiments, were perfectly correct, although he had not taken notes of them himself. In the experiments with weights falling from a height, the deflection of the hollow appeared to be generally about half that of the solid axles. The impression on his mind was that the hollow were superior to the solid axles, but he should very much wish to see further experiments made, as the Patent Shaft and Axle-tree Company seemed confident, in the letter they had addressed to him, that the results would be very different.

It was explained that the Patent Shaft and Axle-tree Company did not say that the solid axles would be found superior to hollow ones, but that the solid axles made by them were stronger than what they were represented by Mr. Yorke to be, and they were only anxious that the question should be fully and fairly investigated. (Hear, hear.)

Mr. Yorke said that his chief improvement was in preventing the crystallization of the iron.

Mr. Taylor said the question had been very much discussed at a recent meeting of the British Association; and most of the scientific gentlemen were of opinion that the injury was done in the manufacture, and not by the vibrations afterwards when the axles were at work upon the railways. Mr. Taylor then detailed some experiments that had been made at the meeting of the association, the result of which was, that axles which were swaged and left to cool of themselves broke easily, while those which were swaged and afterwards annealed retained all the force imparted to them.

In answer to Mr. Alderman Thompson, Mr. Yorke said the burning of the iron, from over-heating, would produce equally injurious effects. Mr. Graham said he had been found that iron bars of the best quality and as levers, had become quite crystallized after two or three weeks' use, and were obliged to be thrown aside.

General Pasley said it appeared to him, from the result of his travelling on railways, that the jumping motion communicated to the axles was equivalent to cold swaging and hammering, and it remained yet to be ascertained whether hollow or solid axles would be best able to resist that action.

Mr. Fox said he was in favour of the hollow axles, but he was of opinion that the experiments made by Mr. Yorke were far from conclusive; for it appeared by his own statement that the journals of the solid axle were both smaller and longer than the journal of his hollow axle with which he compared it; and further, that his firm having sold upwards of 5,000 axles made by the Patent Shaft and Axle-tree Company, they were continually testing them; and that the average result of so testing 42 axles at different times, showed them to be much stronger than the highest result given by Mr. Yorke with regard to his hollow axles. He stated that the Patent Shaft and Axle-tree Company were in the habit of cutting each end of the axles only partially off whilst hot, leaving the ends to be broken off when cold, in order that if the iron were injured in the process of manufacture it might be discovered. He should be glad to see further experiments made, which would enable them to arrive at some satisfactory result.

The Proprietor of the Patent Shaft and Axle-tree Company stated that the matter must be one of great interest to the railway companies; and as Mr. Yorke had referred the strength of their axles to the very superior quality of iron which they manufactured, they would make 10 hollow axles of the same kind of iron as their solid ones, and honestly endeavour to make them as good as possible, then let the whole be tried in any way that competent parties might think proper.

The Chairman hoped the result would be communicated to the association. He was very much gratified with the harmonious and pleasant way in which the subject had been treated by two gentlemen whose interests might be supposed to be diametrically opposed, and it appeared well for the ultimate beneficial results of the experiments which were about to be tried.

Thanks were then voted to Mr. Yorke for his paper, and the meeting broke up.